Stormwater Management Maintenance Workshop

Water Resources Engineering

Fall, 2011

Introduction
Legal Responsibilites

An owner is liable for damages resulting from a dam's misoperation or failure that would result in a sudden release of water downstream.

Strict Liability

- An owner is liable for damages to another in the event a pond or other type of facility fails.

Negligence

- Failure to act or the failure to act in a responsible manner.
- It is the owner's responsibility and obligation to act in a reasonable manner to inspect and maintain a stormwater management facility.

Riparian Rights

- Water released from a pond must be done in a manner which protects the rights of the downstream property owners.

Harford County Code 214-43 Maintenance Responsibilities

The Code was amended to include the inspections of ESD treatment systems.

The owner is responsible for the maintenance, repair and restoration of a facility

The owner will develop and follow a maintenance schedule for the entire life of the facility

Harford County Code 214-44 Maintenance Responsibilities

The owner will receive notification from the County and be given 30 days to perform the work satisfactorily

The County may complete the work and the costs recovered through property liens placed on the beneficial users.

The County may deny all future permits to the owners of a swm facility until the corrections are completed.

The County may revoke all existing permits to the owners of a swm facility until the corrections are completed..

COMAR 26.17.02.01

- applies to all new development and redevelopment projects that do not have final approval for erosion and sediment control and stormwater management plans by May 4, 2010.
- to maintain after development, as nearly as possible, the predevelopment runoff characteristics, and to reduce stream channel erosion, pollution, siltation and sedimentation, and local flooding by implementing environmental site design to the maximum extent practicable

Stormwater Management Act 2007

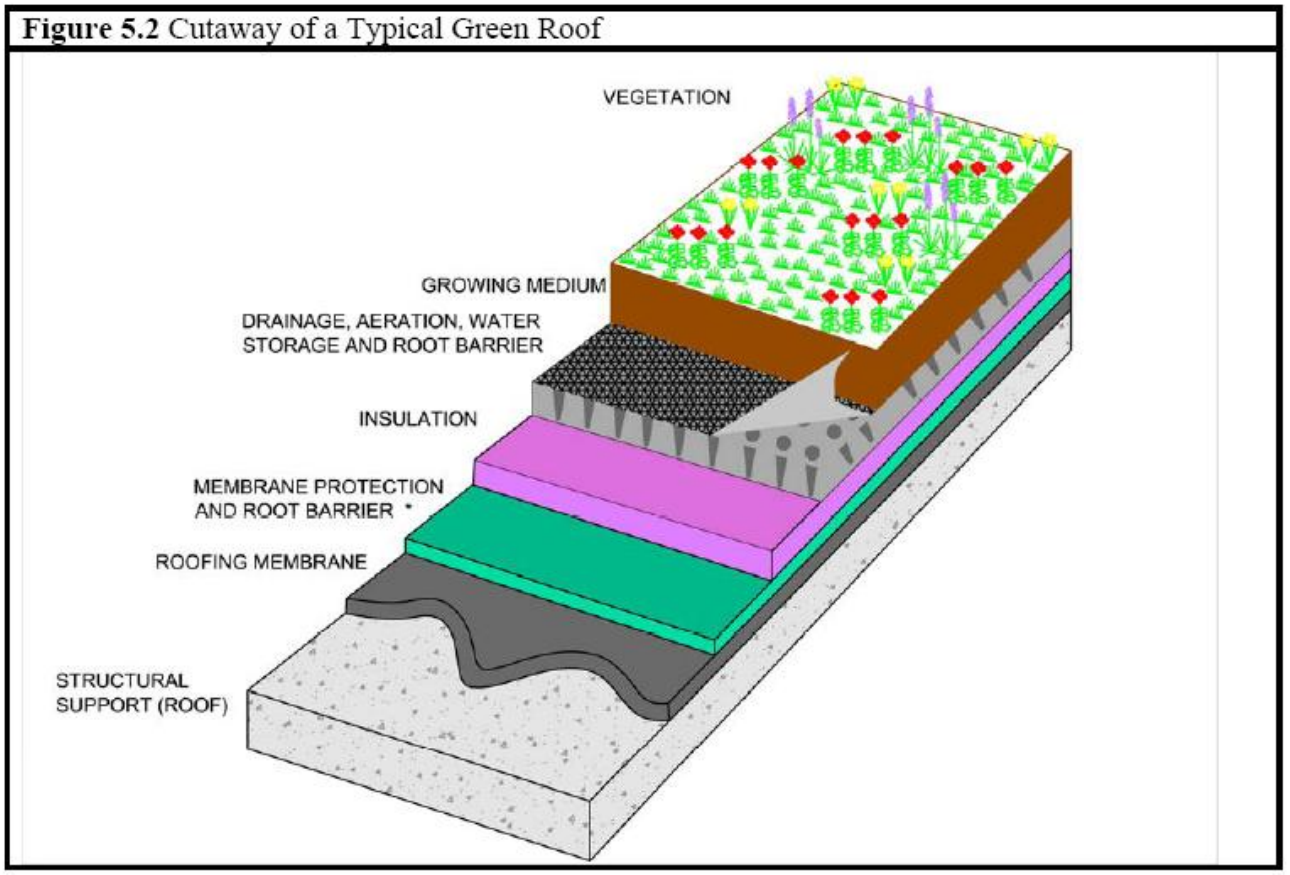
- Prevent increases in nonpoint pollution
- Minimize pollutants in Stormwater runoff
- Maintain 100% of the average annual runoff from both new and redevelopment
- Prevent increases in the frequency and magnitude of out-of-bank flooding from large, less frequent storms.

What is ESD and MEP

- ESD – environmental site design
- Goal is to use small scale swm practices and non-structural techniques to mimic natural run-off characteristics.
- MEP – maximum extent practicable
- “Water quality volume” means the volume needed to capture and treat 90 percent of the average annual runoff volume at a development site.

Green Roofs

Figure 5.2 Cutaway of a Typical Green Roof

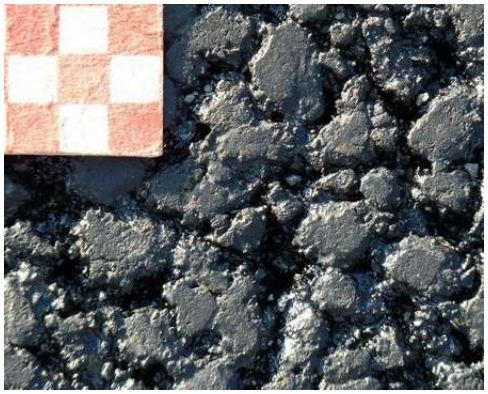


Green Roof Maintenance

- Occasional weeding
- Inspect and maintain open drainage channels
- Inspect for leaks around vent pipes and vertical walls

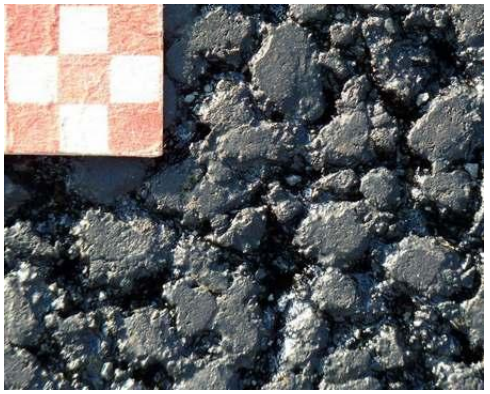
Permeable Pavement

- Porous bituminous asphalt
- Pervious concrete
- Permeable interlocking concrete pavement



Porous Bituminous Asphalt

Hot rolled asphalt



Porous asphalt

Porous Bituminous Asphalt Maintenance

Table 1. Typical Maintenance Activities for Porous Pavement (Source: WMI, 1997)	
Activity	**Schedule**
•Avoid sealing or repaving with non-porous materials	N/A
•Ensure that paving area is clean of debris •Ensure that paving dewaters between storms •Ensure that the area is clean of sediments	Monthly
•Mow upland and adjacent areas, and seed bare areas •Vacuum Sweep frequently to keep the surface free of sediment •(Typically three to four times per year)	At least twice a year
•Inspect the surface for deterioration or spalling	Annual

Porous Bituminous Asphalt

- Resists freeze-thaw; liquid deicers recommended; saturation when frozen may damage asphalt
- Deicing chemicals, such as calcium magnesium acetate or pretreated salt in moderation
- Set snow plows 1” above ground surface
- Do not use washing system or compressed air to clean the surface

Pervious Concrete

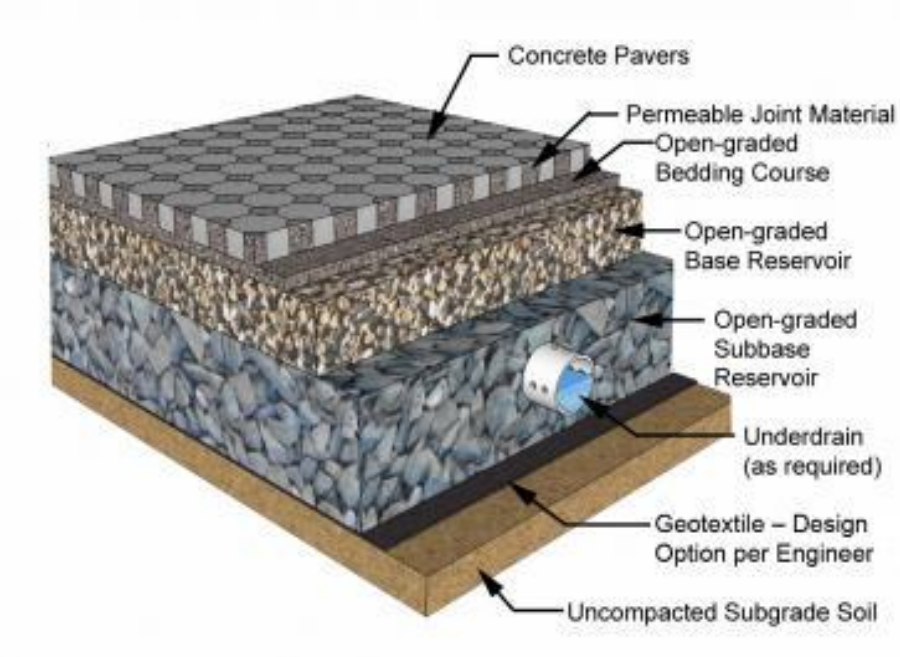
Pervious Concrete Maintenance

- Vacuuming at least twice a year or more often may be necessary to remove debris from the surface of the pavements. Other cleaning options may include power blowing and pressure washing. Pressure washing of a clogged pervious concrete pavement has restored 80% to 90% of the permeability in some cases. It also should be noted that maintenance practices for pervious concrete pavements are still being developed.
- Drainage pipes should be cleaned at regular intervals

Pervious Concrete

- Deicing chemicals, such as calcium magnesium acetate or pretreated salt in moderation
- Set snow plows 1” above ground surface
- Do not use washing system or compressed air to clean the surface

Permeable interlocking concrete pavement



Permeable interlocking concrete pavement (PICP) is comprised of a layer of concrete pavers separated by joints filled with small stones. Water enters joints between solid concrete pavers and flows through an "open-graded" base, i.e. crushed stone layers with no small or fine particles. The void spaces among the crushed stones store water and infiltrate it back into the soil subgrade.

Permeable interlocking concrete pavement

Vacuum and sweep to remove sediment and debris at least twice a year

Remove aggregates if deeply clogged with sediment

Do not use sand for traction during snow.

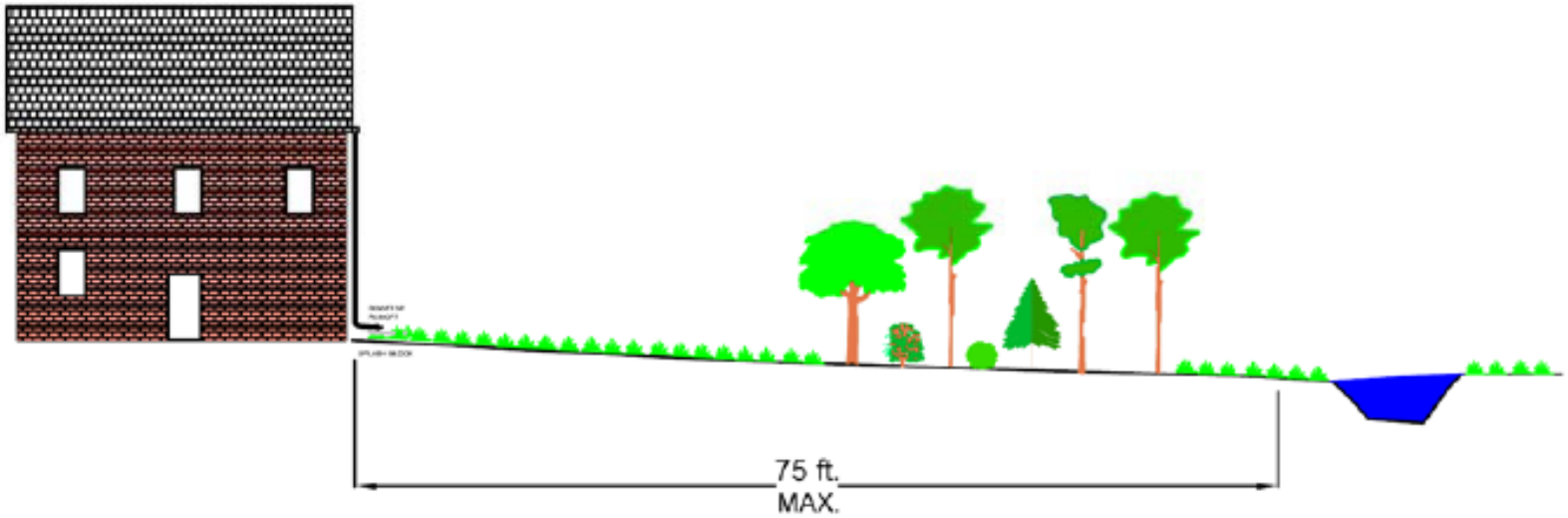
Reinforced Turf

Reinforced Turf Maintenance

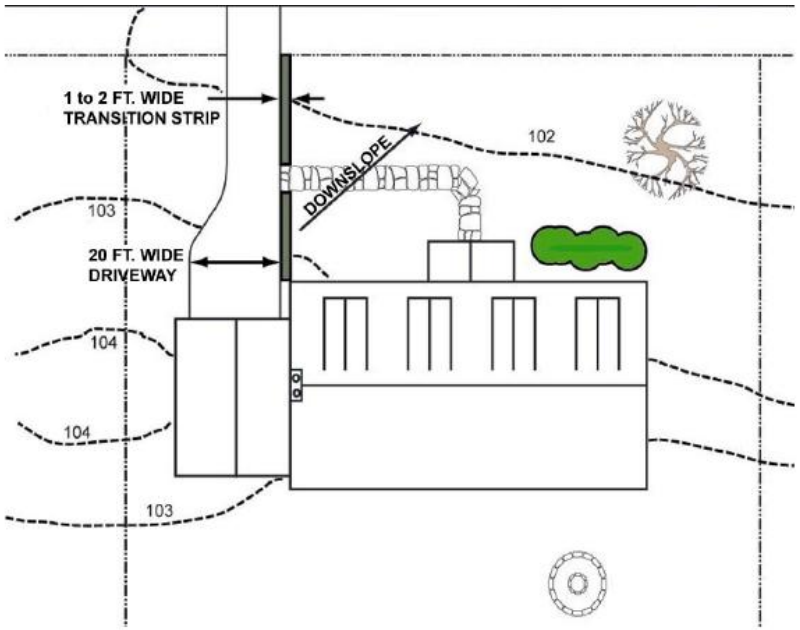
- Do not plant trees or shrubs adjacent to turf where root penetration may become a problem
- Mow regularly and remove clippings

- Heavy vehicular traffic can damage the grids
- Clean drainage pipes on a regular schedule

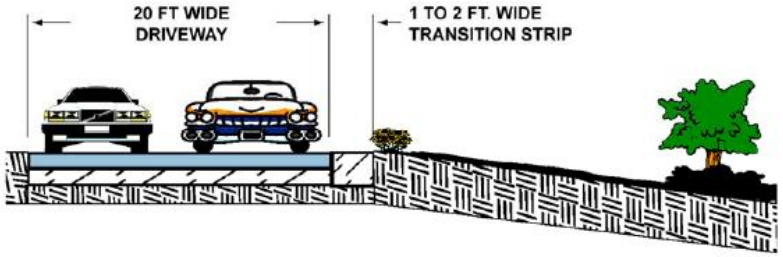
Rooftop Runoff Disconnections – directing water from downspouts across vegetated areas

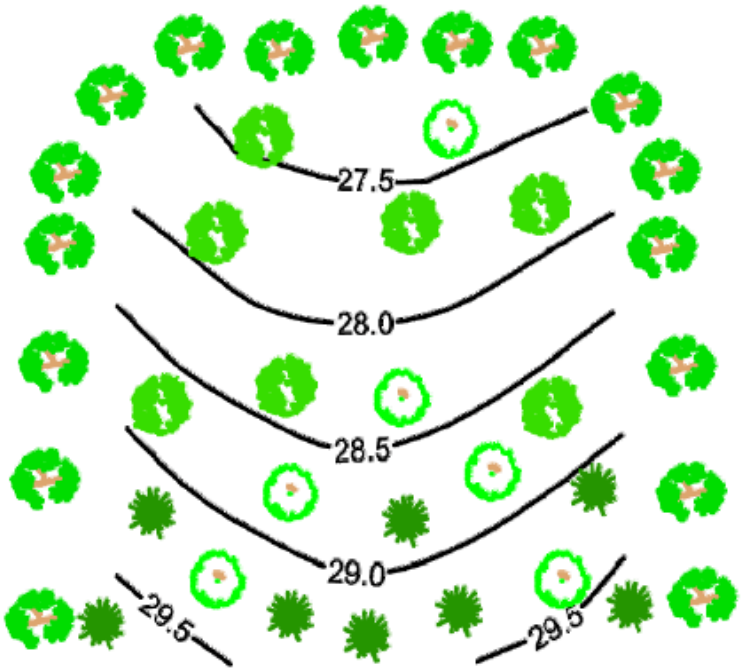


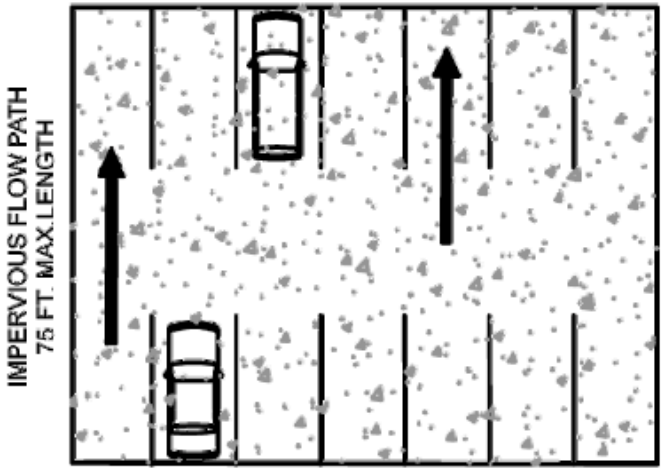
Non-rooftop Disconnections



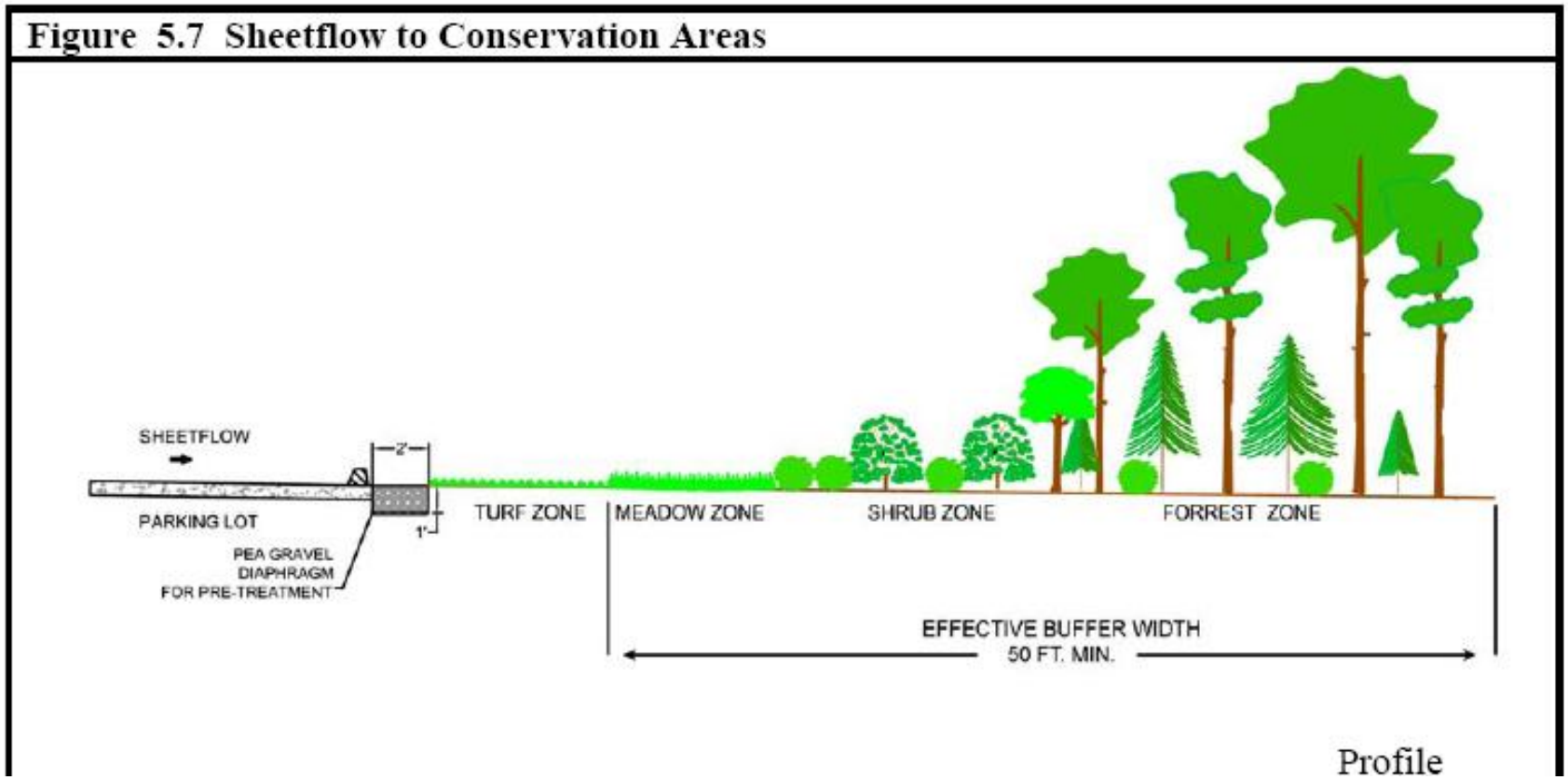
Plan View







Sheet flow to Conservation Areas



Sheet flow to Conservation Areas Maintenance

- Conservation areas shall remain unmanaged other than debris and erosion repair
- Remove invasive and noxious weeds
- Mow meadow areas twice a year

Micro-Scale Practices

- Rainwater Harvesting
- Submerged Gravel Wetlands
- Landscape Infiltration
- Infiltration Berms
- Dry Wells
- Micro-Bioretention
- Rain Gardens
- Swales
- Enhanced Filters

Rainwater Harvesting

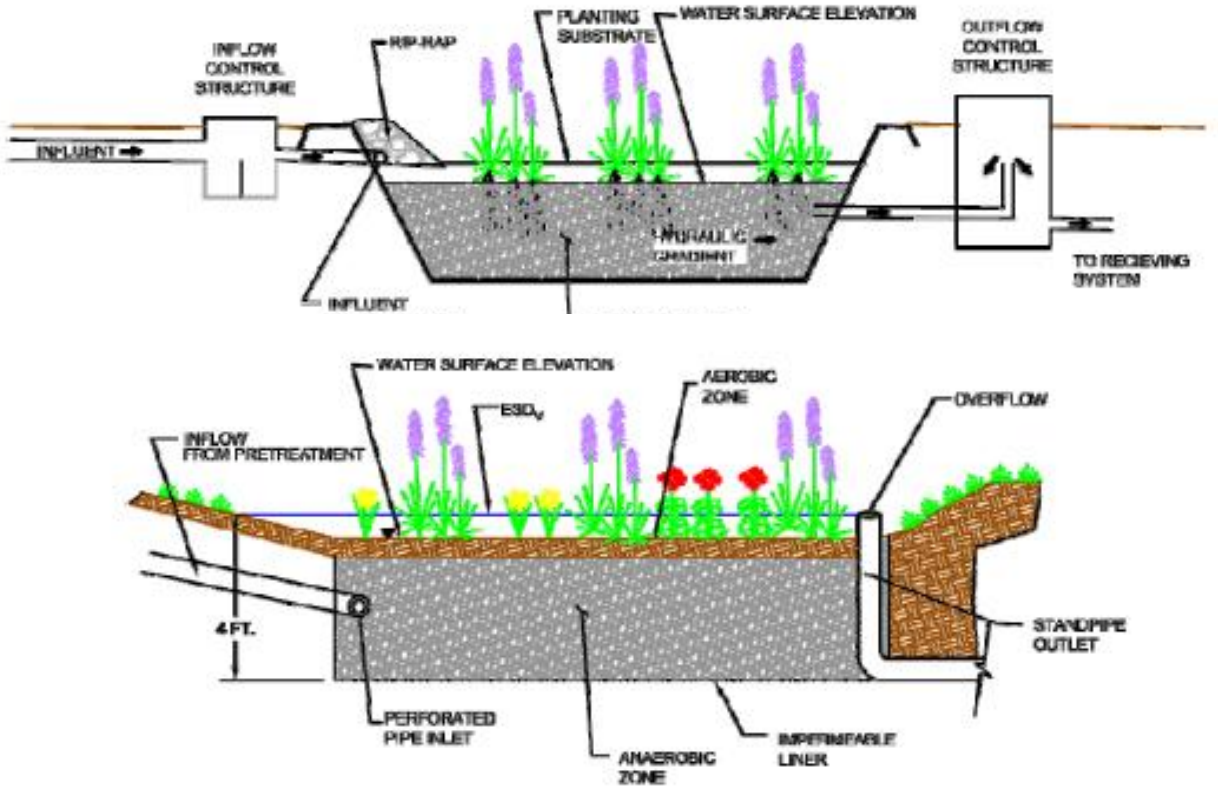
- Cisterns – large underground holding tanks
- Rain barrels

Rainwater Harvesting Maintenance

- Clean leaf screens and gutters
- Replace damaged components
- Disconnect and drain for the winter
- May utilize mosquito dunks within the barrels

Submerged Gravel Wetlands

- Wetland plants in a saturated rock media



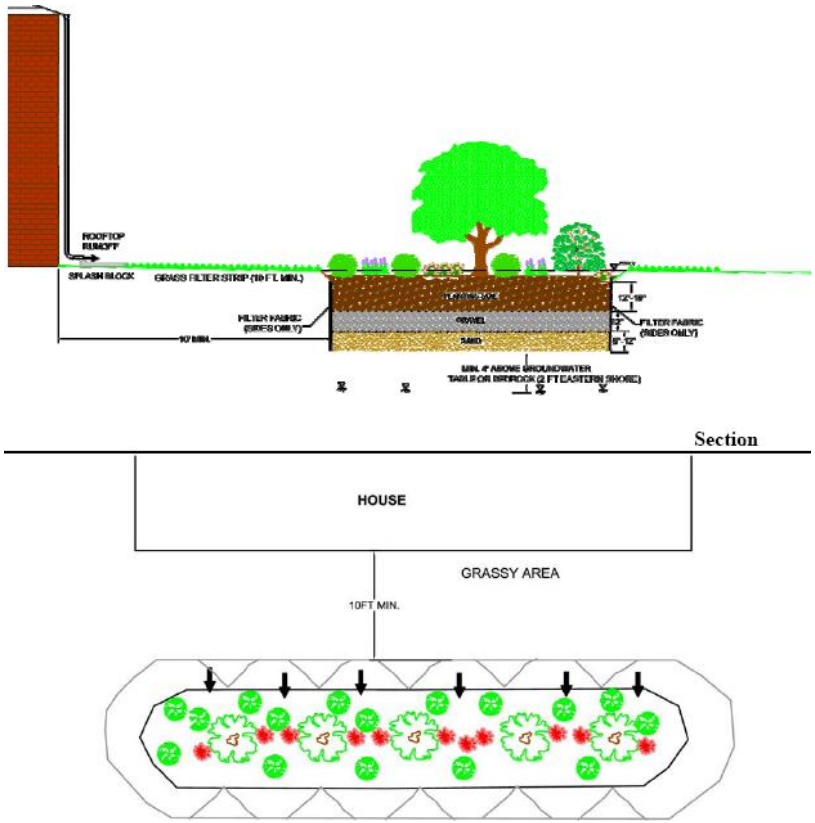
Submerged Gravel Wetlands

Gravel Wetlands, Bio-swales, Grass Pavers, and Pea Gravel Diaphragms

Submerged Gravel Wetlands Maintenance

- Remove sediment from the pretreatment area (forebay)
- Uneven flow distribution may mean the gravel or underdrain is clogged. The stone and underdrain may require removal and replacement.
- Remove trash and debris from inlet and outlet structures.
- Repair erosion areas and inspect flow splitters.
- Replant vegetation as necessary.

Landscape Infiltration- onsite vegetative areas that capture, store, and treat runoff.

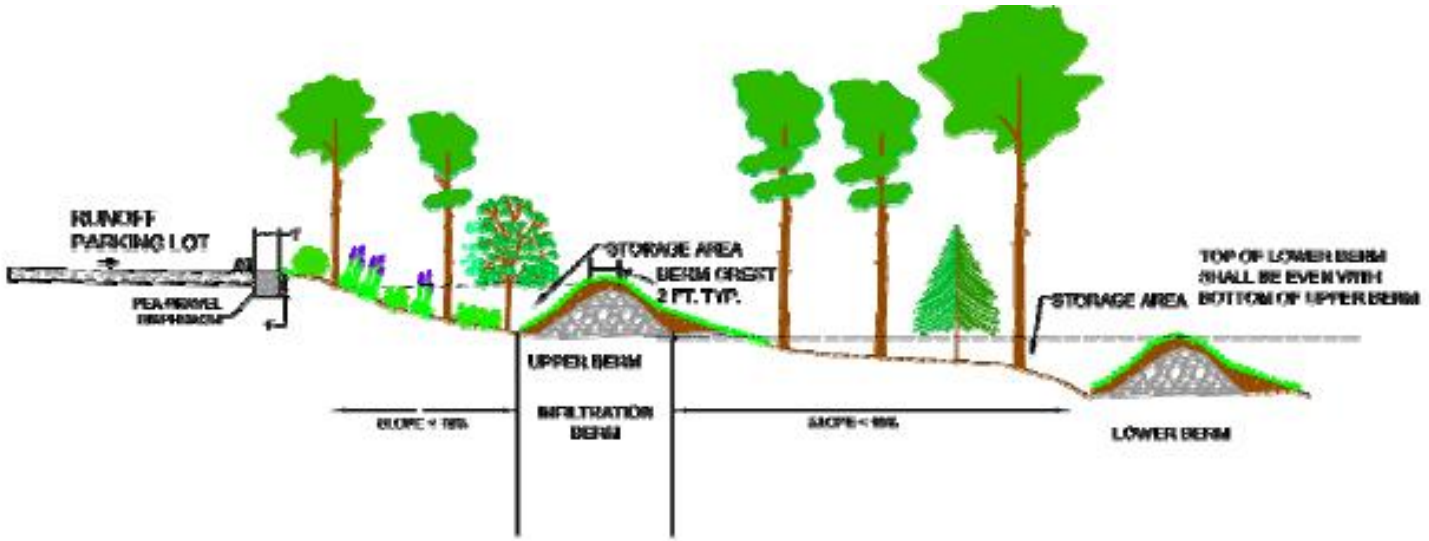


Landscape Infiltration Maintenance

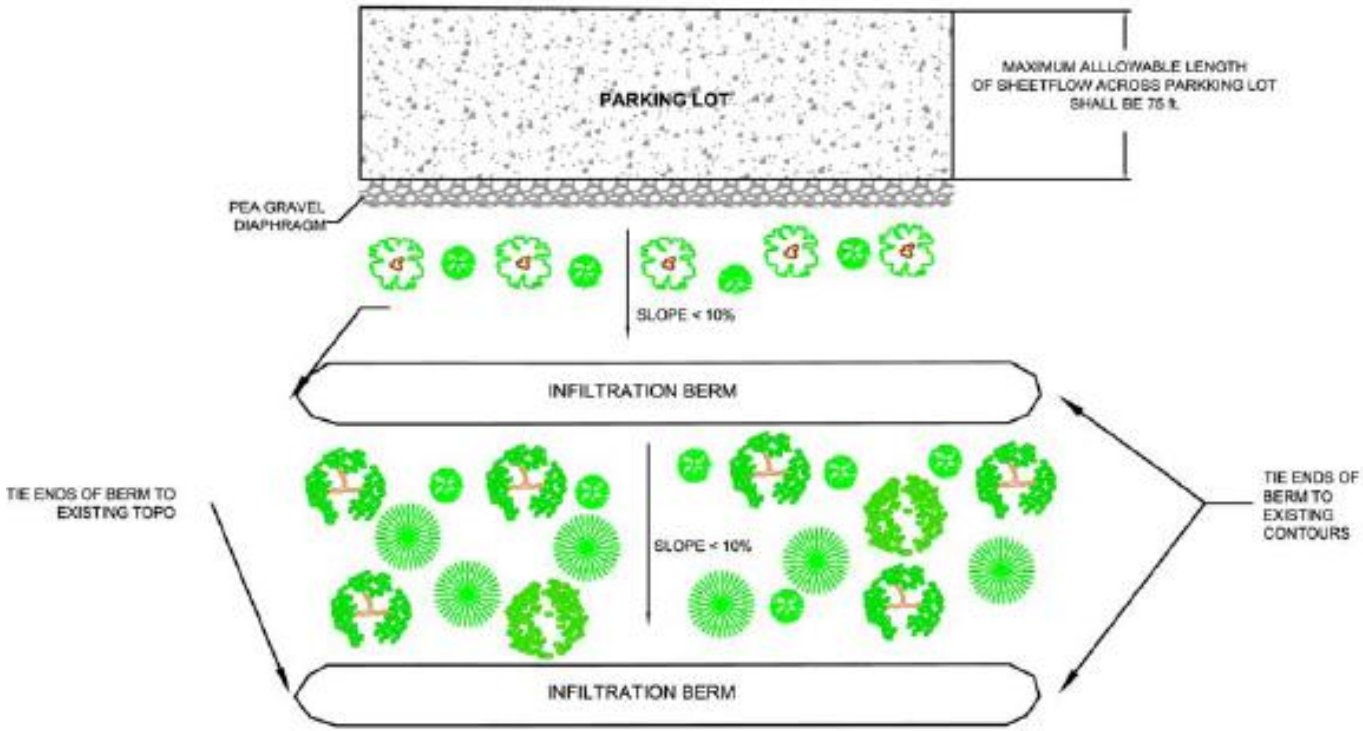
- Remove sediment and 2-3” of material and replace with new planting soil.
- If there is algal growth or the facility does not drain within 48 hours, the soil, gravel, and sand may need to be replaced.
- . Replace dead plantings and prune as needed.

Infiltration Berms

- An infiltration berm is a mound of earth composed of soil and stone that is placed along the contour of a gentle slope.


RUNOFF
PARKING LOT
PEA GRAVEL
DIAPHRAGM
STORAGE AREA
BERM CREST
2 FT. TYP.
UPPER BERM
INFILTRATION
BERM
SLOPE < 10%
STORAGE AREA
TOP OF LOWER BERM
SHALL BE EVEN WITH
BOTTOM OF UPPER BERM
LOWER BERM

Section


PARKING LOT
MAXIMUM ALLLOWABLE LENGTH
OF SHEETFLOW ACROSS PARKKING LOT
SHALL BE 75 ft.
PEA GRAVEL
DIAPHRAGM
SLOPE < 10%
INFILTRATION BERM
TIE ENDS OF BERM TO
EXISTING TOPO
SLOPE < 10%
TIE ENDS OF
BERM TO
EXISTING
CONTOURS
INFILTRATION BERM

Infiltration Berms Maintenance

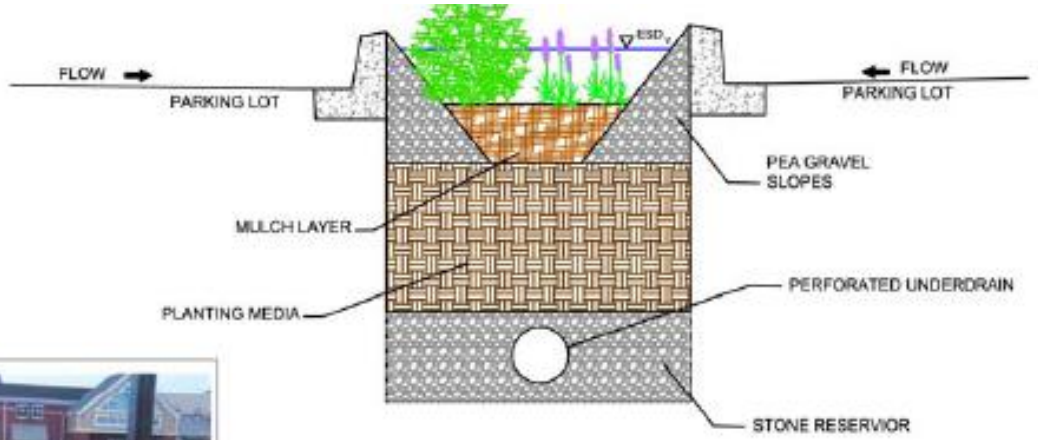
- Ensure sheet flow across the berms
- Dense vegetation must be present at all times.
- Repair erosion areas.

Dry Wells – excavated pit containing stone

Dry Well Maintenance

- Keep gutters and gutter drain filter clean.
- If water ponds longer than 48 hours, or that more than 6” of sediment has accumulated, the gravel media will require replacement.

Micro-Bioretention

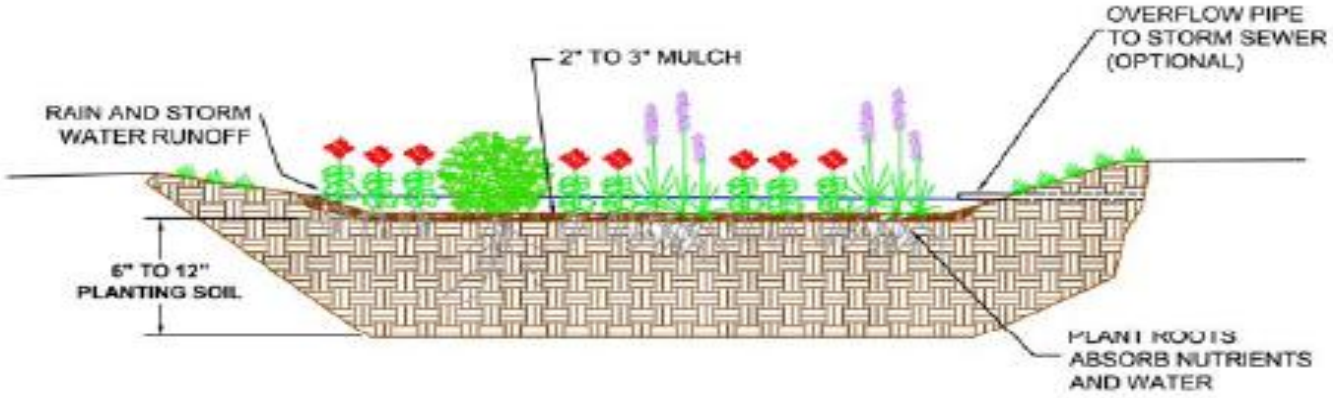


Micro-Bioretention Maintenance

- Remove top few inches of filter media if water ponds more than 48 hours.
- Remove sediment and silt when accumulation is more than 1”.
- In parking lots and roads, replace mulch annually. In other areas, replace top 2-3” as necessary.
- Repalce dead vegetation and prune as needed.

Rain Gardens

Rain Gardens



Remove top few inches of filter media if water ponds more than 48 hours.
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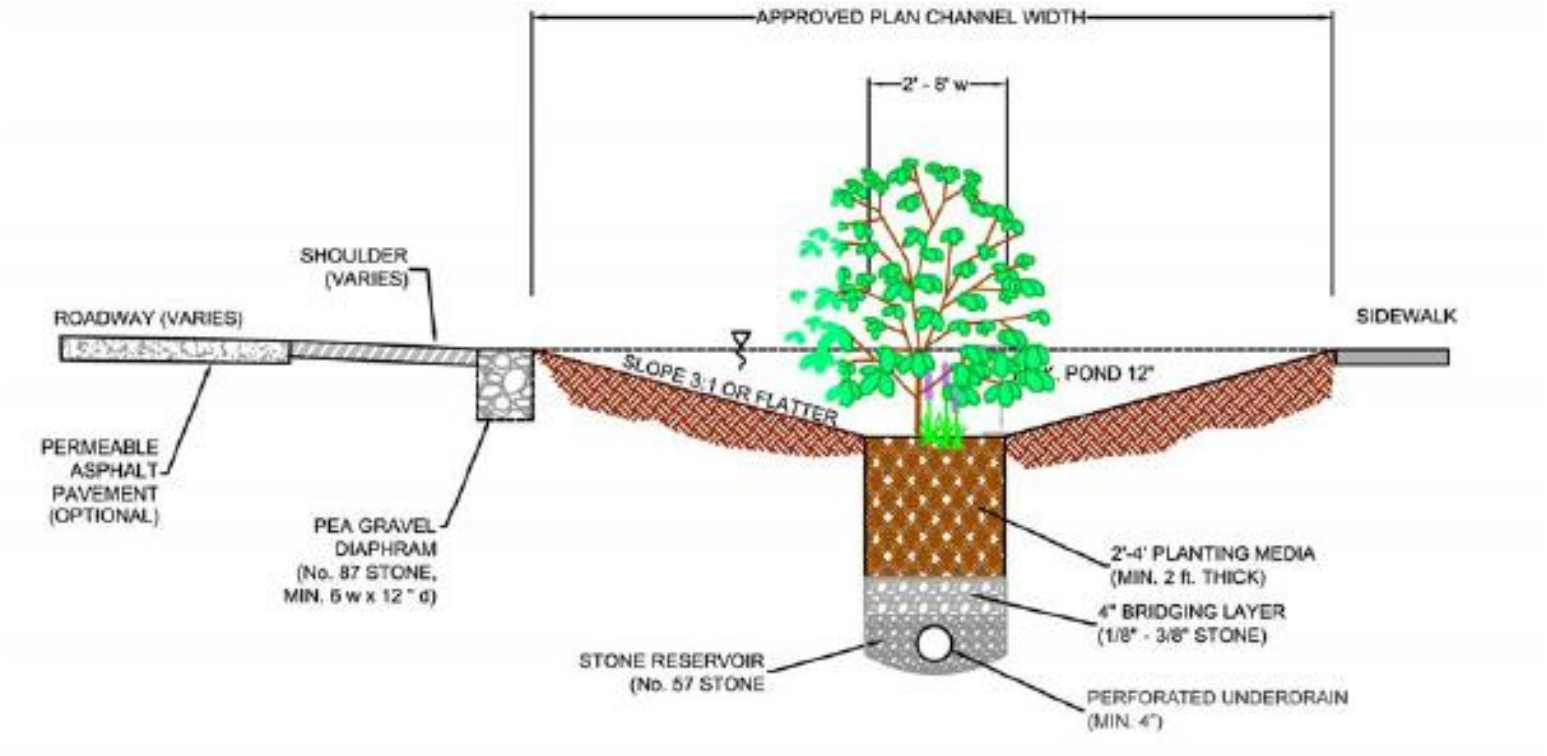
Repalce dead vegetation and prune as needed.

Bio-Swales


APPROVED PLAN CHANNEL WIDTH
2' - 8' w
SHOULDER
(VARIES)
ROADWAY (VARIES)
SIDEWALK
SLOPE 3:1 OR FLATTER
POND 12"
PERMEABLE
ASPHALT
PAVEMENT
(OPTIONAL)
PEA GRAVEL
DIAPHRAM
(No. 87 STONE,
MIN. 6 w x 12 " d)
2'-4' PLANTING MEDIA
(MIN. 2 ft. THICK)
4" BRIDGING LAYER
(1/8" - 3/8" STONE)
STONE RESERVOIR
(No. 57 STONE
PERFORATED UNDERDRAIN
(MIN. 4")

If the swale does not drain within 48 hours, till the bottom soil and revegetate.

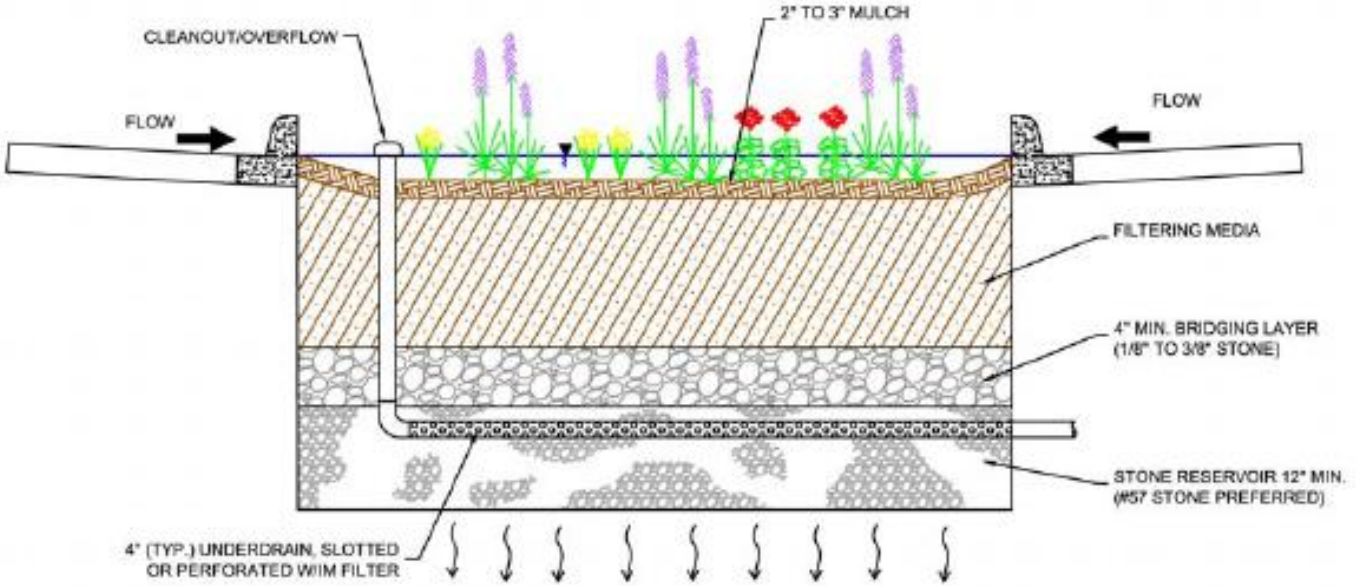
Remove sediment and debris.

Repair all eroded areas.

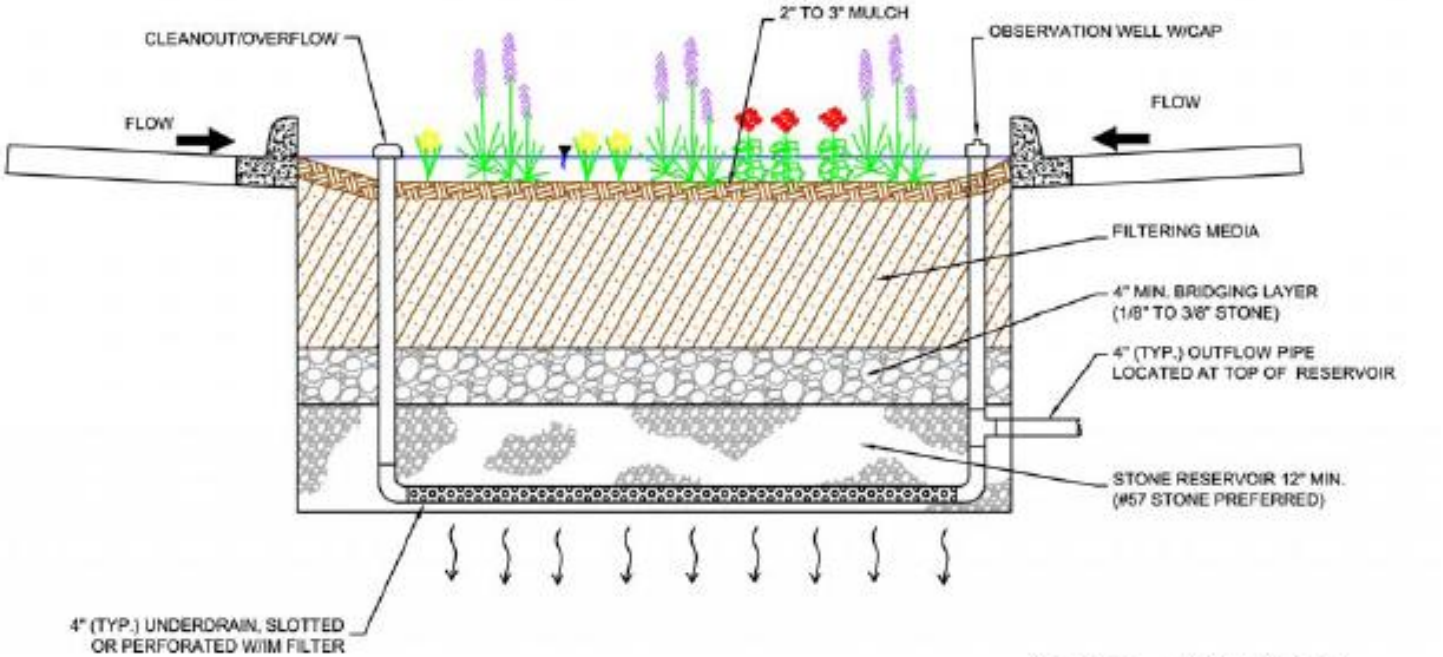
Provide dense vegetative cover.

Enhanced Filters

- Maintain as a micro-bioretention facility.



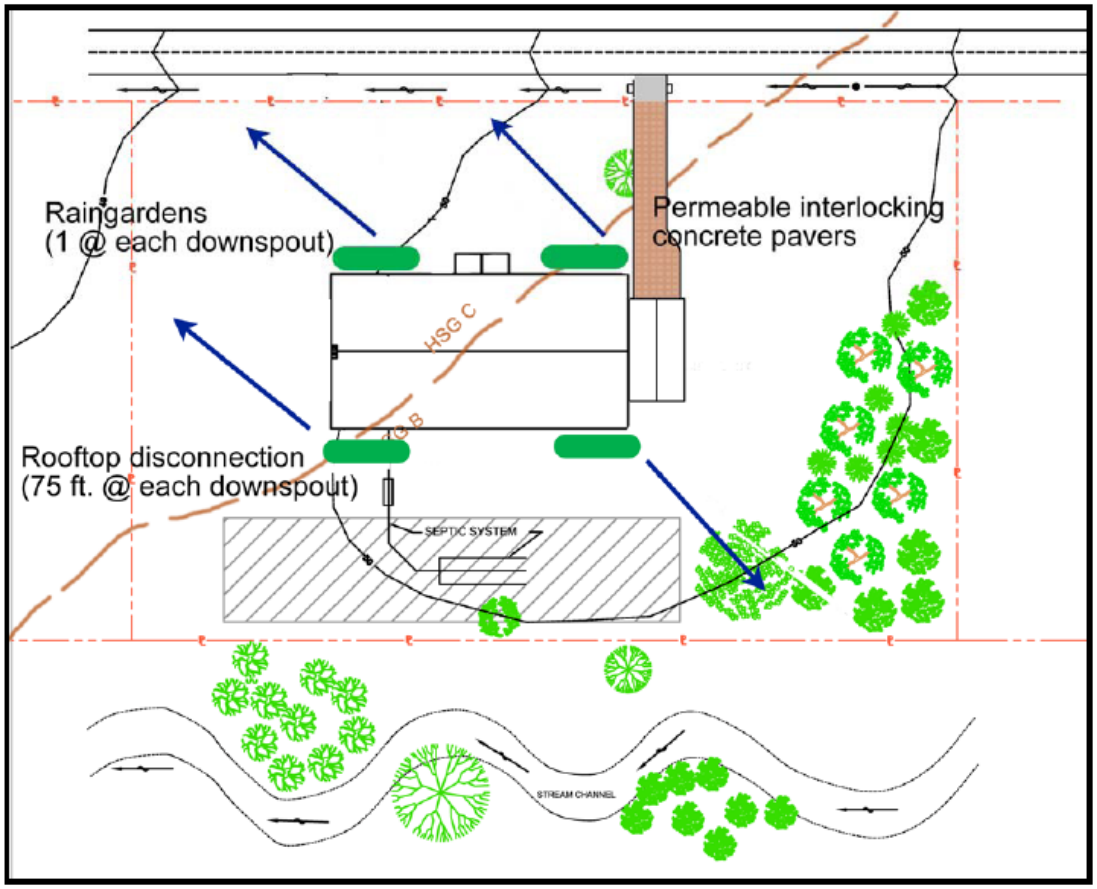
Section -Variation 1



Section – Variation 2

ESD for Single Family

Figure 2. Concept Design Layout of ESD Practices and Techniques



Types of Stormwater Management Facilities

Retention Ponds – Wet Ponds

Detention Ponds

Extended Detention Ponds

Infiltration Basin

Shallow Marsh

Infiltration Trench
High's Madonna

Sand Filter
Sediment Forebay

Surface Sand Filter

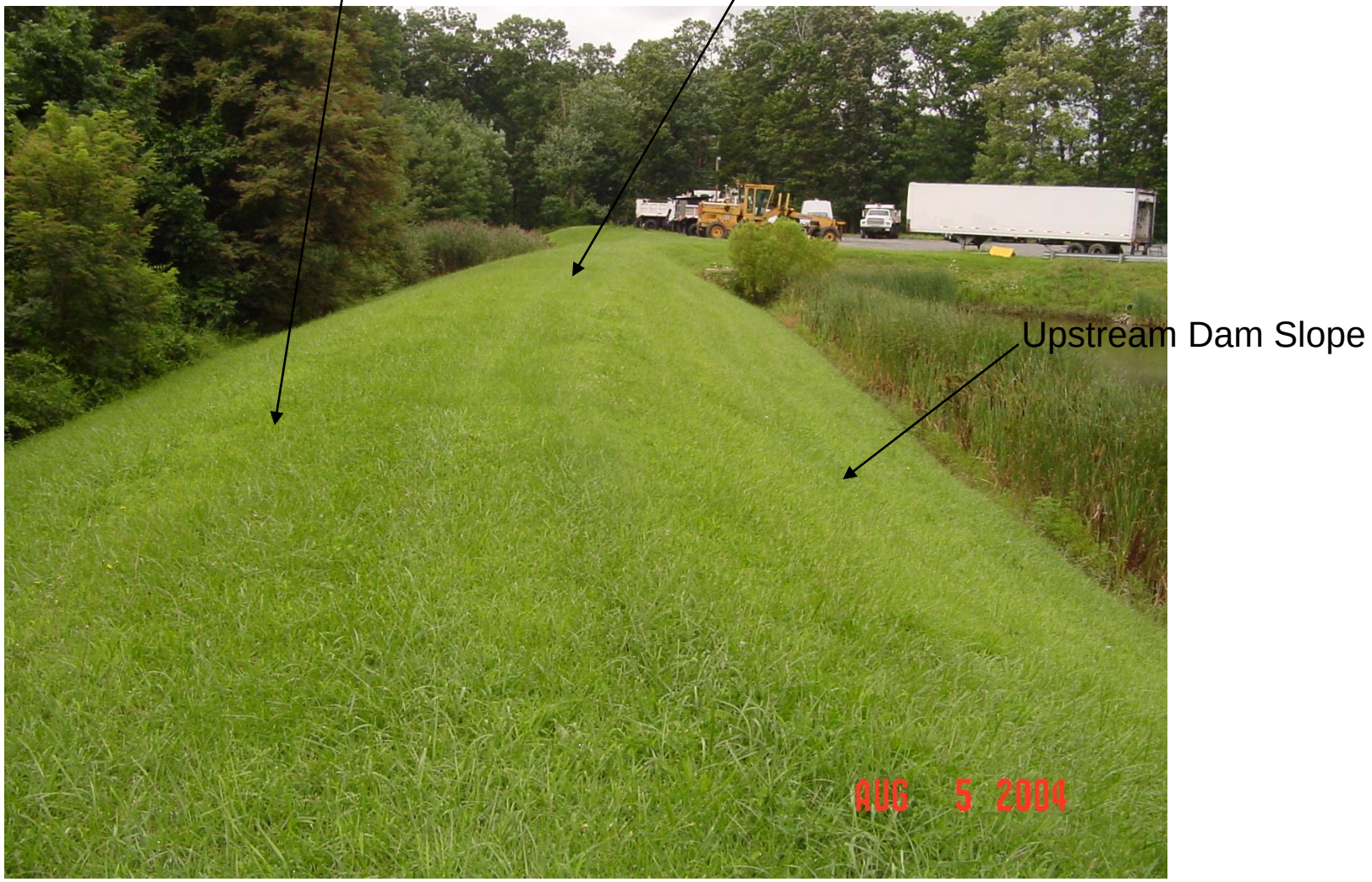
Sediment Forebay

Surface Sand Filter -Lowes

Organic Sand Filter

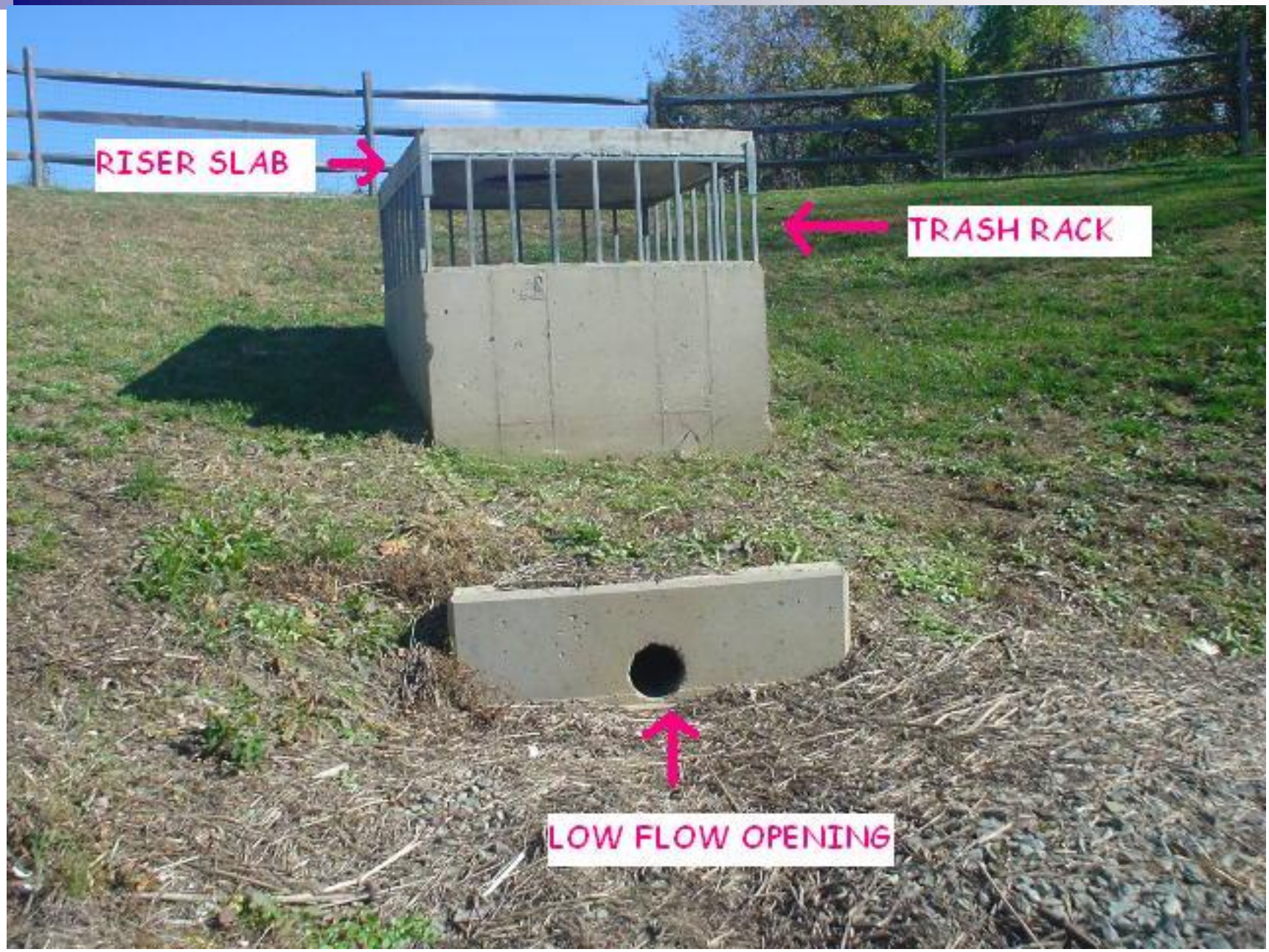
Bioretention

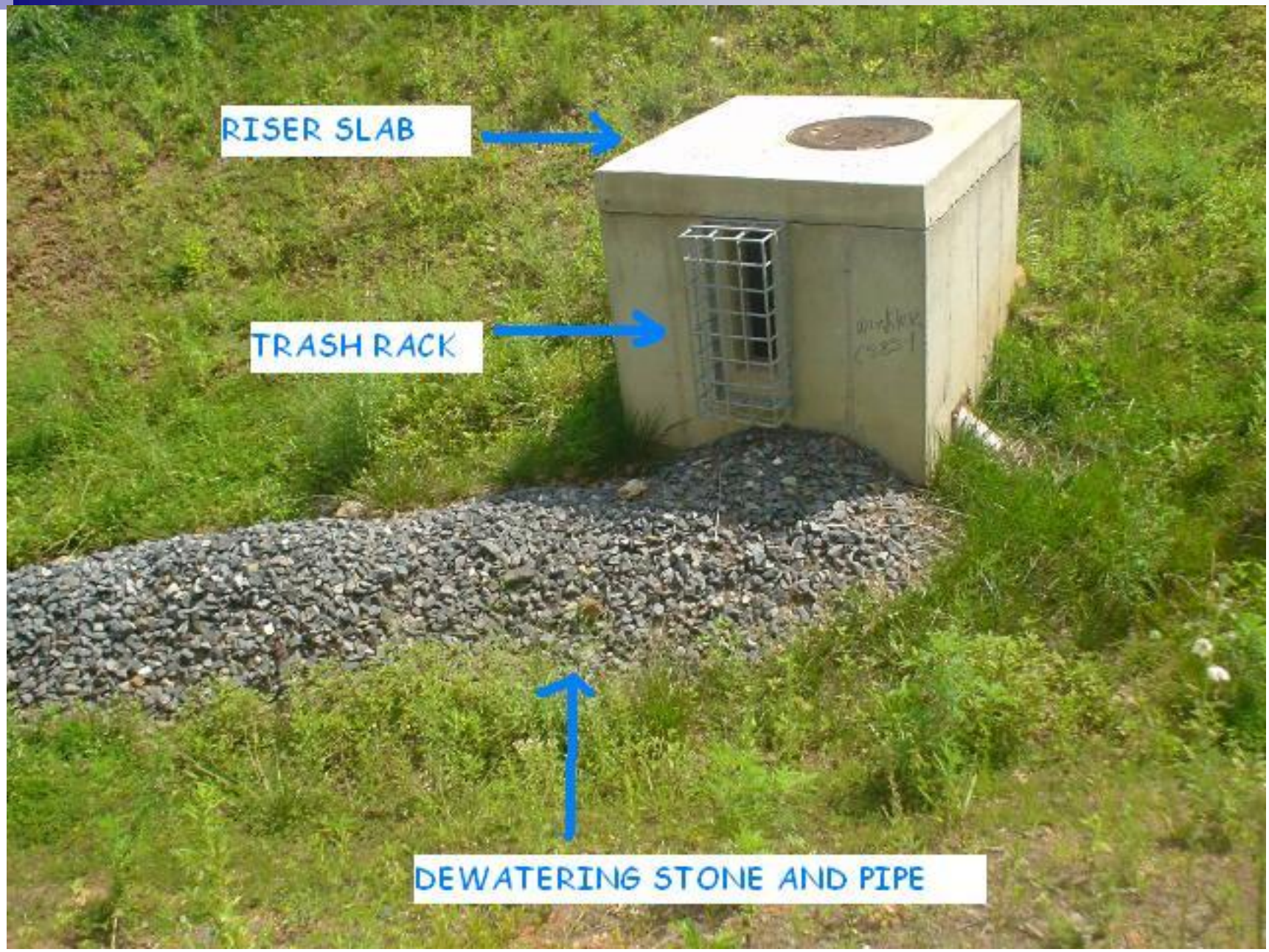
Open Channel


Downstream
Dam Slope
Top of Dam
Upstream Dam Slope
AUG 5 2004

Emergency Spillway

Safety Bench


RISER SLAB
TRASH RACK
LOW FLOW OPENING


RISER SLAB
TRASH RACK
DEWATERING STONE AND PIPE


ORIFICE PLATE INSIDE RISER


Gate Valve


Agri-drain
APR 5 2006


ANTI VORTEX DEVICE
RISER STRUCTURE
LOW FLOW OPENING

Principal Spillway Pipe with 1 anti-seep collar

Pilot Channel

Maryland 378 Pond Specifications

No trees or shrubs are allowed:

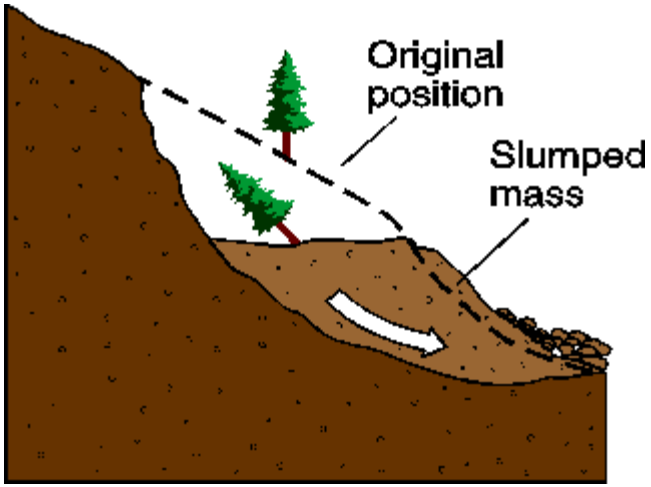
On an dam embankment

Maryland 378 Pond Specifications

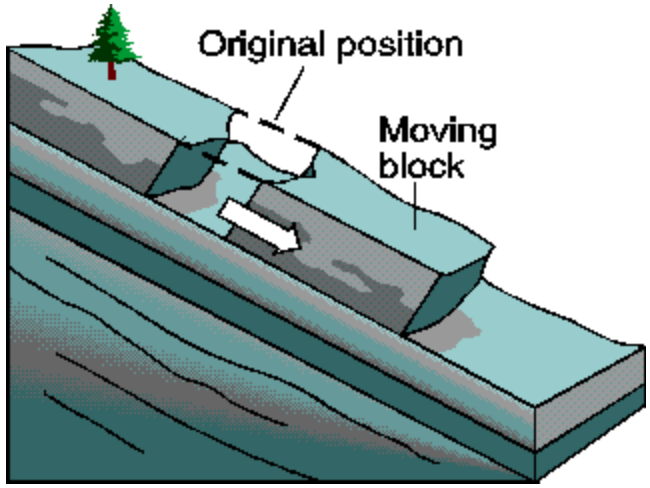
within 15 feet from the toe of the dam

Maryland 378 Pond Specifications

within 25-foot radius around the inlet structure



Slump: complex movement of materials on a slope; includes rotational slump.



Slide: movement parallel to planes of weakness and occasionally parallel to slope.

2” Wide Crack on Top of the Dam

Introduction

- Performing routine maintenance on a stormwater management facility will:
  - Extend the life of the facility
  - Minimize expensive repair costs
  - Avoid adverse downstream impacts


DAM NOT MOWED TO TOE


DAM MOWED TO TOE


Downstream dam slope very overgrown


Downstream slope mowed to toe and outfall cleared


Upstream dam slope very overgrown


Upstream slope mowed


Downstream slope overgrown
Outfall overgrown


DAM SLOPES MOWED TO TOE
AUG 5 2004

Storm Drain Outfall Obstructed

Animal Burrow on Dam

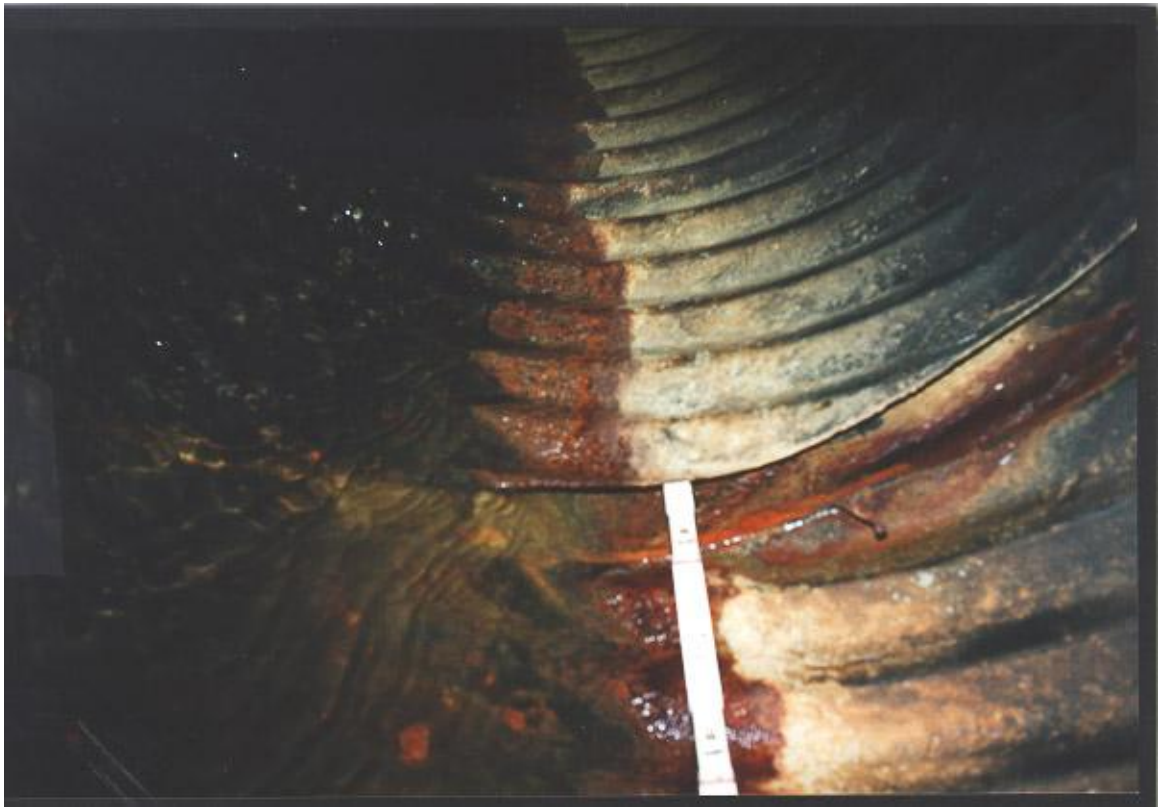

OVERGROWN FENCE

Stone Around the Dewatering Pipe is Clogged with Sediment

Sand Filter Failure


12 3:14 AM

Soil Loss Through Barrel Joint

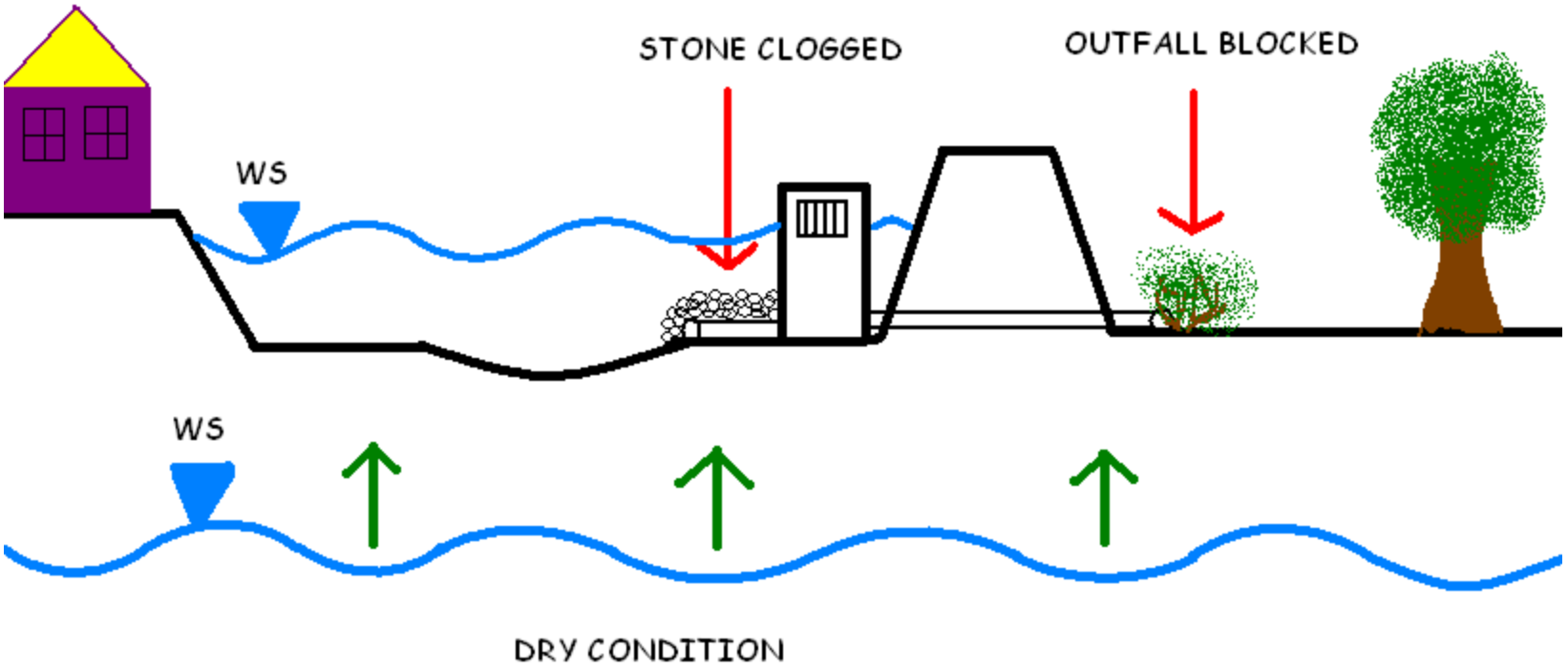


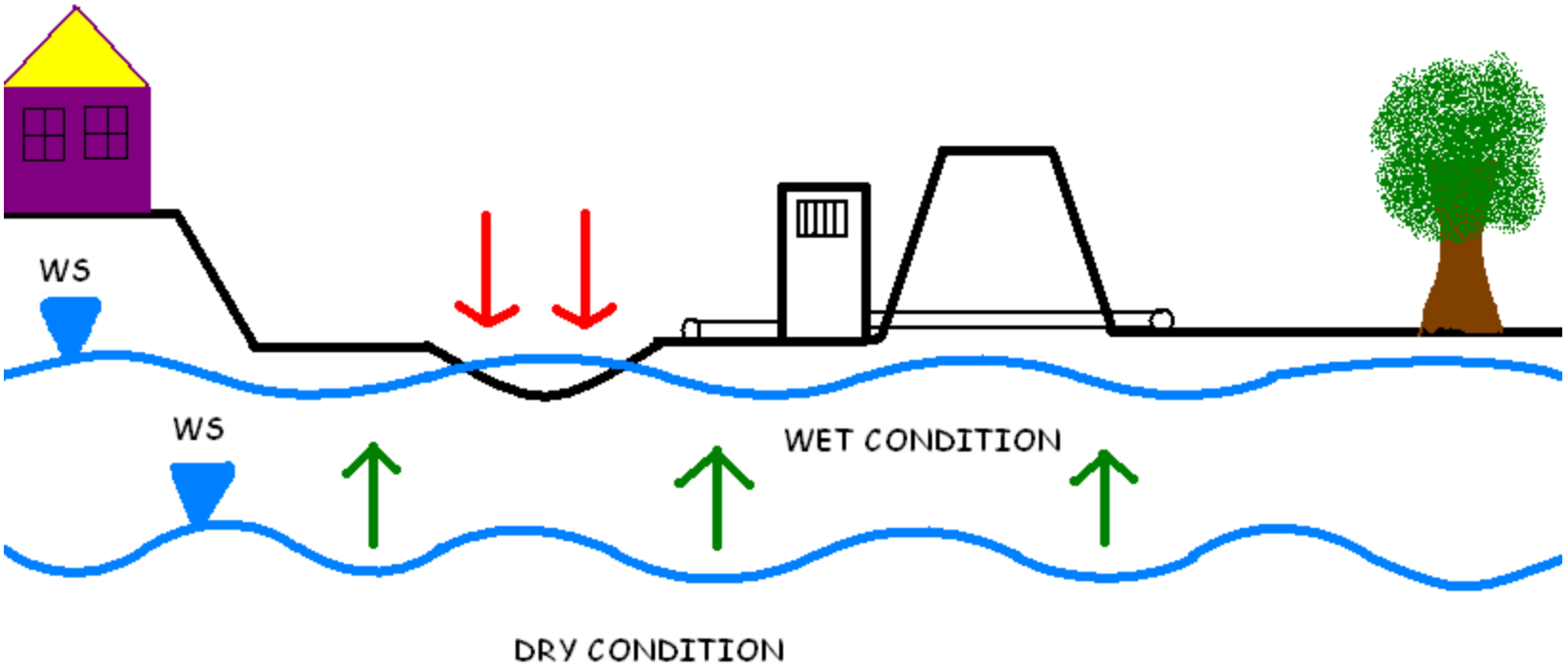
Barrel Joint Opening

Bottom of Barrel Pipe Rusted Through to Ground Surface

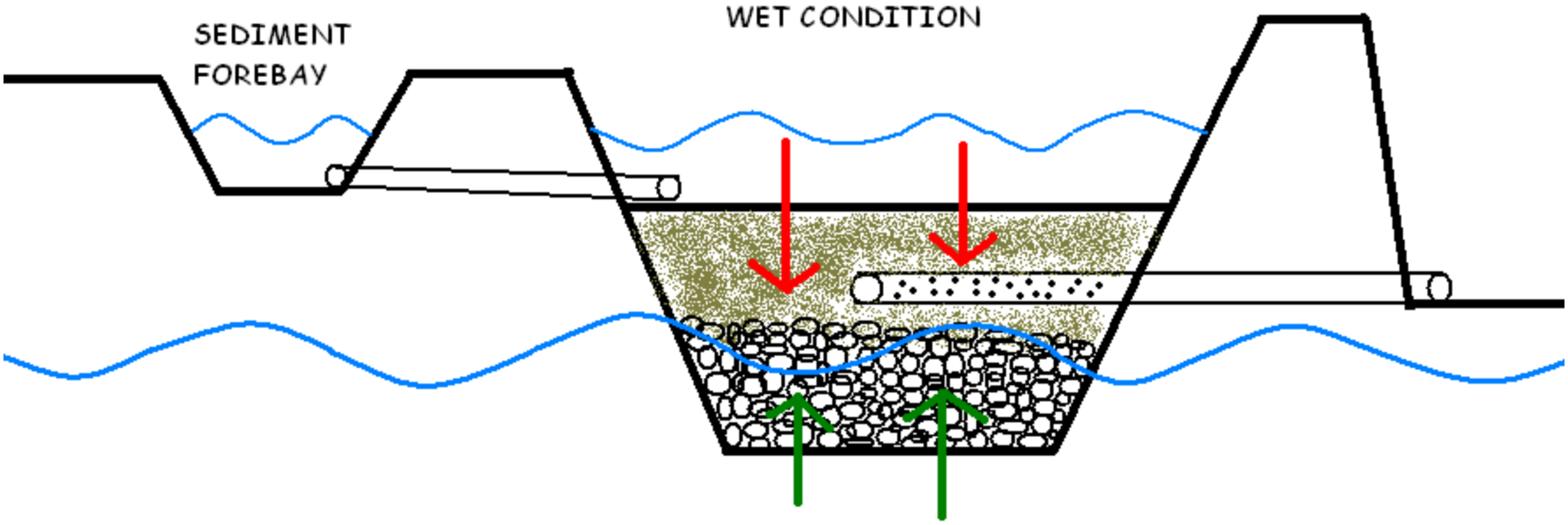
Water Seepage through Riser Walls

Anti-Vortex Device Rusted


STONE CLOGGED
OUTFALL BLOCKED
WS
WS
DRY CONDITION

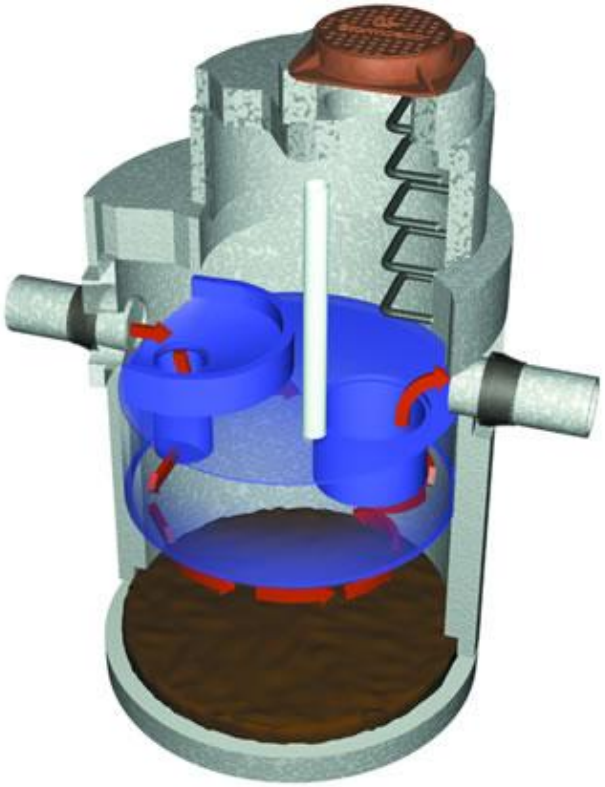

WS
WS
WET CONDITION
DRY CONDITION

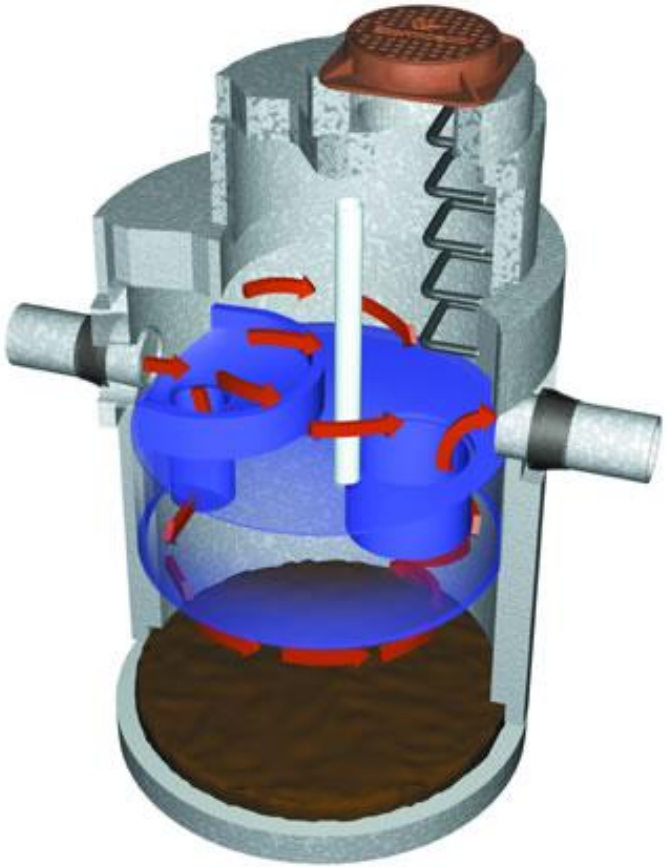
Sand Filter and Sediment Forebay


SEDIMENT
FOREBAY
WET CONDITION


09/20/2006 2:30 pm

Stormceptors

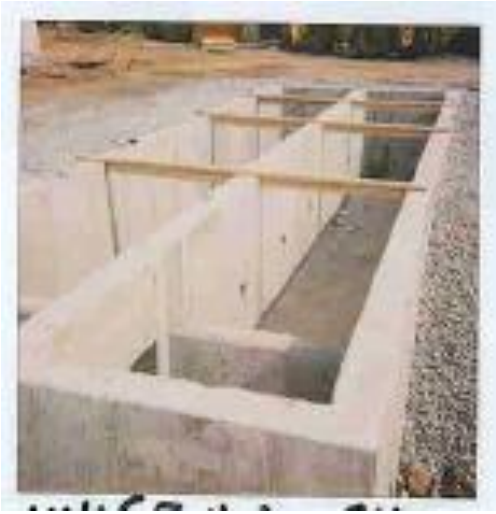




UNDERGROUND STORAGE

PRETREATMENT

Underground Sand Filter Pretreatment Vaults



Gillespie System


05/18/2007 3:23 pm